

# Nutrition



## CHAPTER 5

# Nutrition



- Why do we food?

# Nutrition



- Why do we food?
- Nutrition: taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them.
- How do plants make food?

# Nutrition



- Why do we food?
- Nutrition: taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them.
- How do plants make food?
- Photosynthesis
  - using raw material – carbon dioxide and water – to make sugar
  - The sugar produced is used to make other compounds
  - Plants need other nutrients to make these compounds, such as magnesium

# Nutrition



- Nutrients that animals need are present in their diet
- Nutrients for a balanced diet needed for humans are:
  - Carbohydrates, proteins, fats, vitamins, minerals, fibre, water
- These provide energy and for repairing and making cells and tissues. They are also needed for body functions e.g. for maintaining healthy gut

# Nutrition



- **Nutrients group:**
  - Carbohydrates
  - Proteins
  - Fats

# Carbohydrates



- Contain three elements: carbon, oxygen, hydrogen
- Carbohydrates include sugars and starches
- Glucose: simple sugar [monosaccharide]
- Complex sugar [disaccharide] : TWO simple sugars bonded chemically– all sugars are soluble in water and provide energy in a ready-to-use form
  - Sucrose (glucose + fructose): sugar added to food and drinks
  - Maltose (glucose + glucose): sugar in yeast, grains which have been softened like pasta and cereal
  - Lactose (glucose + galactose): milk sugar

# Carbohydrates



- Complex carbohydrates [polysaccharide]: many simple sugar molecules joined together chemically
  - Plants: complex carb. is starch which store energy – they have enzymes that catalase the reaction of joining glucose molecules together to form long chain
  - Animals: complex carb is glycogen (sometimes called animal starch) – made from joining of glucose as a way to store energy – stored in liver and muscles
  - Starch and glycogen are insoluble in water and don't taste sweet



# Carbohydrates



Glucose/  
Sugar

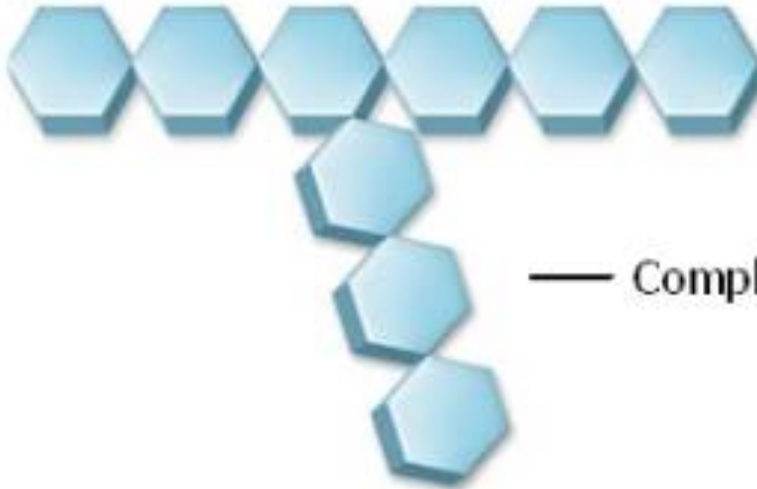


Sucrose



Simple Carbohydrates (Sugars)

Starch



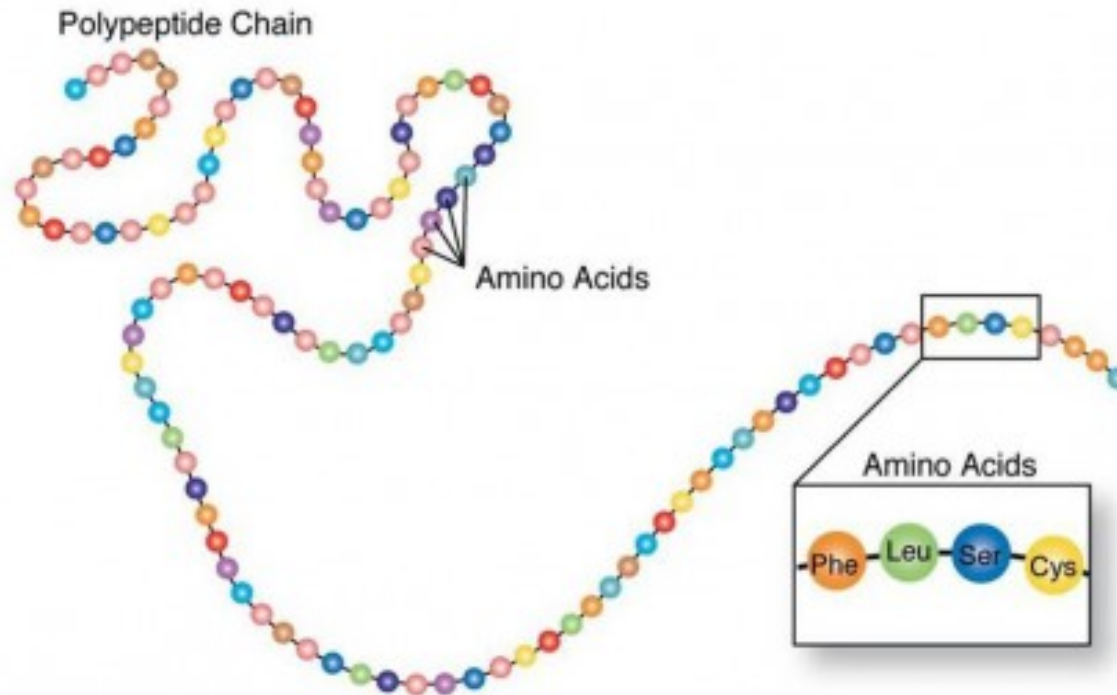
Complex Carbohydrate

# Proteins



- Contain elements: carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur
- Proteins are long chains made from smaller molecules called amino acids.
- After forming they are either folded or form long chains

# Proteins



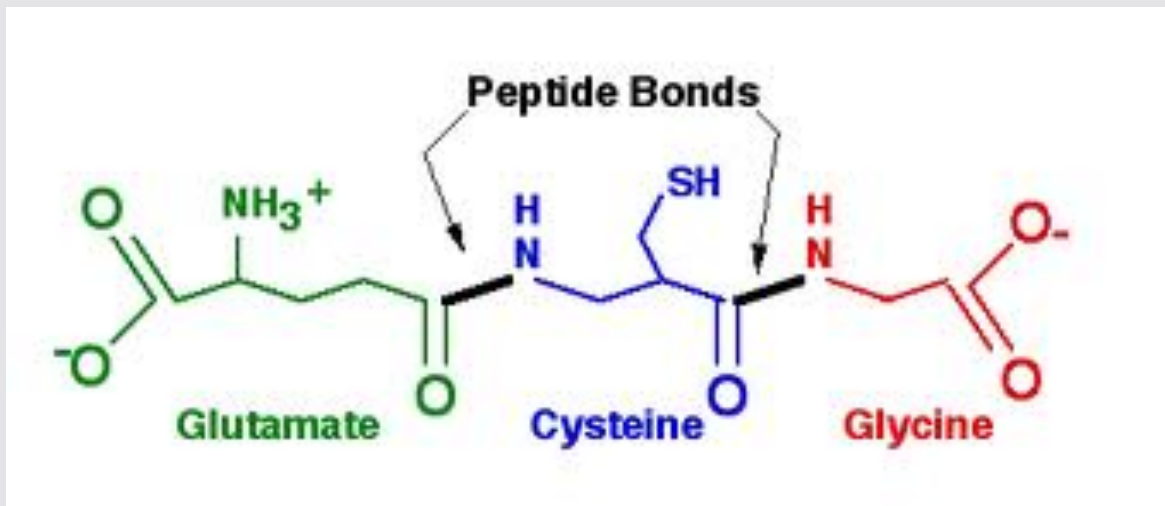
## Amino Acids

Ala: Alanine	Gln: Glutamine	Leu: Leucine	Ser: Serine
Arg: Arginine	Glu: Glutamic acid	Lys: Lysine	Thr: Threonine
Asn: Asparagine	Gly: Glycine	Met: Methionine	Trp: Tryptophane
Asp: Aspartic acid	His: Histidine	Phe: Phenylalanine	Tyr: Tyrosine
Cys: Cysteine	Ile: Isoleucine	Pro: Proline	Val: Valine

# Proteins



- 20 different types of amino acid
- Different sequence of these amino acids determine type of protein
- Amino acids join together through a bond called peptide bond



# Proteins

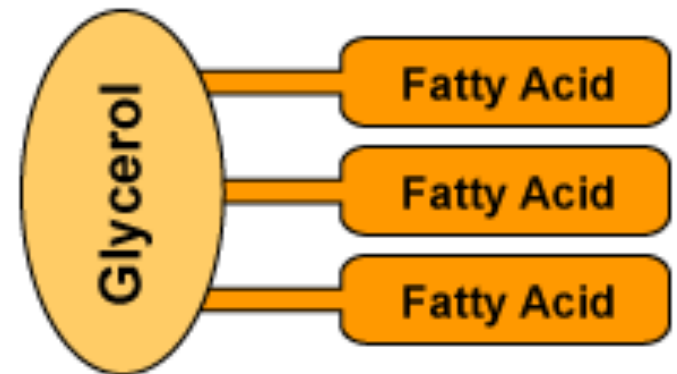


- Soluble proteins: hemoglobin, enzymes, antibodies, some hormones (e.g. insulin)
- Insoluble proteins: used to make fibre in body e.g. Keratin found on skin and hair
- Proteins are important for growth and cell/tissue repair as they are main components in cell membrane

# Fats



- Contain elements: carbon, hydrogen, and oxygen
- Made from: 1 molecule of glycerol + 3 attached fatty acid
- Different types of fatty acids form different fats and hence have different properties
- Fats used as energy storage and thermal insulation of body



# Sources of nutrients



- **Carbohydrates:**
  - Include sugar and starch
  - Ready source of energy
  - Absorbed by stomach into blood stream to give energy
  - Energy released due to respiration (happens in mitochondria)
  - E.g.: rice, potatoes, bread, sugar, honey, yam

# Sources of nutrients



- **Proteins:**
  - For body growth and development/ make new cells
  - Digest proteins into amino acids and then reassemble to make new proteins for body use
  - Used/found in cell membrane and cytoplasm
  - If not used for cell repair then it is used for energy
  - Sources: meat, fish, milk, nuts, beans



# Sources of nutrients



- **Fats**

- Long term energy store / thermal insulators
- Stored under skin and around heart and kidneys
- 1 g of fat energy > 1 g of carb. Energy
- Energy used when body short of energy from carbs
- E.g. marine animals such as whales have thick layer of fat on skin to keep warm
- Sources: butter, cheese, fat in meat and fish, nuts

# Sources of nutrients



- **Water**
  - 2/3 of body is water
  - You can't survive without water (few days)
  - Needed for chemical reactions
  - Blood transports substances dissolved in water
  - Body waste requires water (urine)
  - Sweat to cool down
  - Loss of water in urine + sweat + breath + faeces should equal water daily intake

# Sources of nutrients



- **Fibre**

- From plants
- Made from plant cell wall (cellulose)
- Even if not digested by body, minerals from it are needed
- Passes through gut from mouth to anus
- Muscles from gut wall need something to put against
- Helps food to move along alimentary canal (prevents constipation)
- Absorbs poisonous waste from gut bacteria
- Reduces concentration of cholesterol in blood and therefore reduces heart disease
- Reduces risk of bowel disease
- Sources: bran cereal, cabbage, sweetcorn, celery

# Sources of nutrients



- **Vitamins**
  - Read table on page 49

# Chemical tests



- Test presence of starch, sugars, proteins and fats in food
- Before test:
  - Make an extract of material being tested. Grind it up (blender or mortar and pestle) to small amounts and add some water.
  - Add drops of indicators
  - Test also with substances that you know have the substance you are testing and doesn't. (positive and negative results)

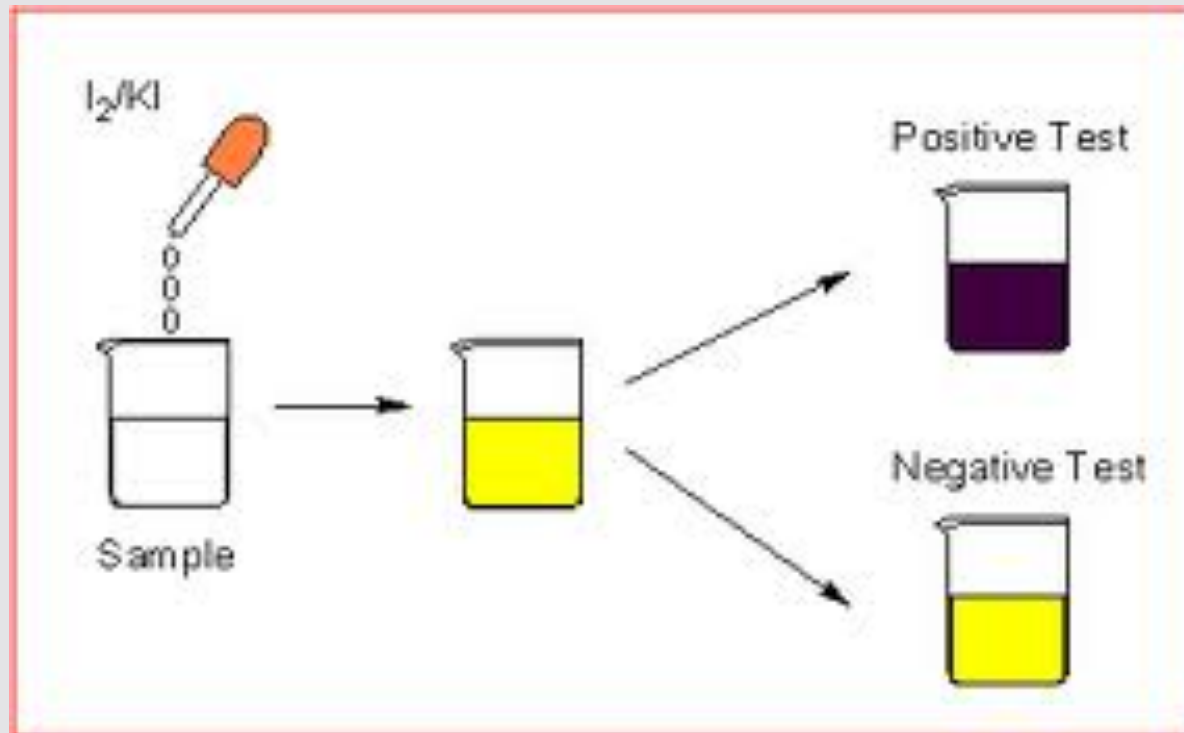


# Chemical tests



- Testing starch

- Use: iodine
- Changes from yellow/light brown to blue/black



# Chemical tests



- Testing reducing sugars

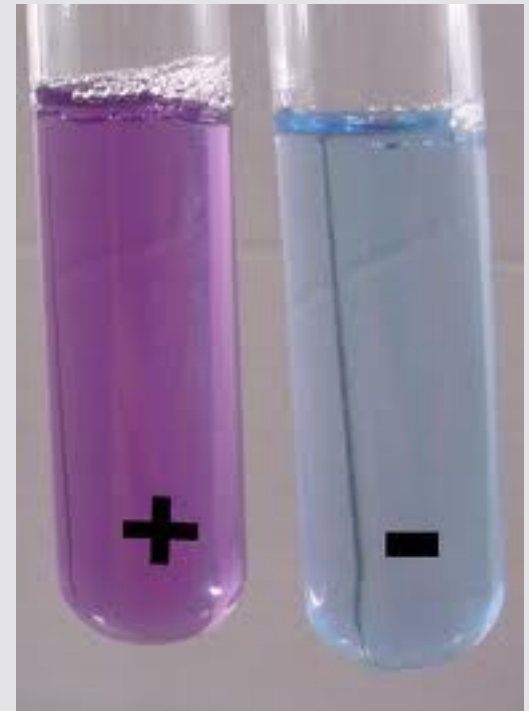
- Tests simple sugars, like glucose, and SOME complex sugars (sucrose is NOT a reducing sugar)
- Place substance tested in a hot water bath
- Add: benedict solution (bright blue color)
- Changes to green: little sugar
- Changes to green then orange: lots of sugar
- If you leave test tube to cool you will also observe precipitate



# Chemical tests



- Testing for protein
  - Use: drops of biuret solution
  - Changes from blue to purple/violet/lilac





# Chemical tests



- **Testing for fat**

- Fact: fats don't dissolve in water. So **DON'T ADD WATER WHEN PREPARING SOLUTION**
- Chop/ grind substance
- Add ethanol and shake
- Add some water and shake
- White emulsion (cloudy/milky color) is a positive test for fat



# Food additives



- They are chemicals that are added to manufactured food
- Food additives could be:
  - Preservatives: to keep food fresh
  - Flavoring: to replace the flavor of food often lost in processing
  - Coloring: to make food look more appealing/ appetizing
- Side effects:
  - Asthma, headaches, over-activity in children, vitamin damage

# Animal Nutrition



## CHAPTER 7

# Basic functions of nutrients



- Provide energy
- Allow growth and repair
- Regulate body metabolism

# Basic functions of nutrients

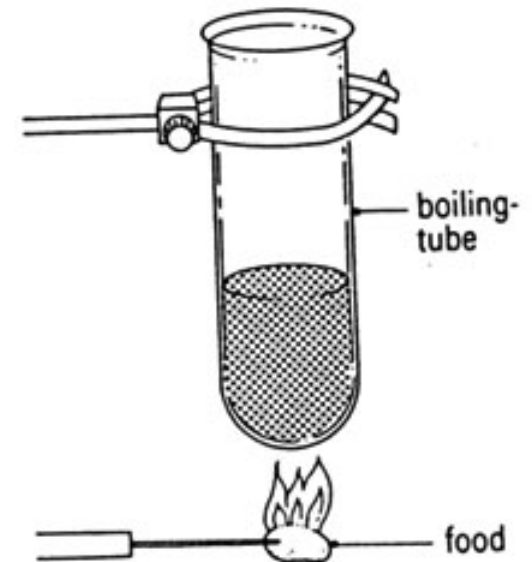


- Provide energy (carbs + fats ; sometimes protein if in excess)
- Allow growth and repair (protein)
- Regulate body metabolism (vitamins + Minerals)

# Measuring energy in food



- How to find how much energy content in food?
  - Burn food
  - Food burning releases heat
  - Heat is used to heat up water
  - The more the temperature difference, the more energy is released from that food.
- Unit for energy: kilojoules (kJ)
- 1 kJ = 1000 Joules



# Measuring energy in food



- Most food have their energy content on label
- Amount given in kJ/100g



## Food Labels

The nutrition information on food labels tells us what a food contains. The label also tells us how much energy is stored in the food. The energy is measured in **kilojoules (kJ)**.

A typical food label is shown for a flan. Do you think the flan contains a good balance of the main food groups?

NUTRITION INFORMATION		
TYPICAL VALUES (cooked as per instructions)		
	per FLAN	per 100g
ENERGY	1462 k J. 351 k cal	975 k J. 234 k cal
PROTEIN	9.0g	6.0g
CARBOHYDRATE	28.2g	18.8g
of which sugars	3.0g	2.0g
of which starch	25.2g	16.8g
FAT	22.3g	14.9g
of which saturates	7.6g	5.1g
of which mono-unsaturates	10.9g	7.3g
of which polyunsaturates	2.7g	1.8g
FIBRE	1.6g	1.1g
SODIUM	0.6g	0.4g
per FLAN	351 CAL	22.3g FAT
GUIDELINE DAILY AMOUNTS		
EACH DAY	WOMEN	MEN
CALORIES	2000	2500
FAT	70g	95g
OFFICIAL GOVERNMENT FIGURES FOR AVERAGE ADULTS		

# Measuring energy in food



- Most food have their energy content on label
- Amount given in kJ/100g

## Nutrition Facts

Serving Size ½ cup (125 g)  
Servings Per Container 3

Amount Per Serving

**Calories 100**      **Calories from Fat 10**

	% Daily Value*
<b>Total Fat</b> 4g	<b>7%</b>
Saturated Fat 0g	<b>0%</b>
<b>Cholesterol</b> 0mg	<b>0%</b>
<b>Sodium</b> 250mg	<b>10%</b>
<b>Potassium</b> 530mg	<b>15%</b>
<b>Total Carbohydrate</b> 8g	<b>3%</b>
Dietary Fiber 1g	<b>4%</b>
Sugars 7g	

**Protein** 8g

Vitamin A 10%      • Vitamin C 25%

Calcium 2%      • Iron 10%

\*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories: 2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:

Fat 9 • Carbohydrate 4 • Protein 4

## Nutrition Facts

Serving Size ½ cup (125 g)  
Servings Per Container 3

Amount Per Serving

**Calories 152**      **Calories from Fat 0**

	% Daily Value*
<b>Total Fat</b> 0g	<b>0%</b>
Saturated Fat 0g	<b>0%</b>
<b>Cholesterol</b> 0mg	<b>0%</b>
<b>Sodium</b> 250mg	<b>10%</b>
<b>Potassium</b> 530mg	<b>15%</b>
<b>Total Carbohydrate</b> 30g	<b>10%</b>
Dietary Fiber 1g	<b>4%</b>
Sugars 29g	

**Protein** 8g

Vitamin A 10%      • Vitamin C 25%

Calcium 2%      • Iron 10%

\*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories: 2,000	2,500
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Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:

Fat 9 • Carbohydrate 4 • Protein 4

Regular

Fat-free



# Food intake



- Depends on what?

# Food intake



- Depends on:
  - Body size
  - Gender
  - Activity level
  - Work
  - Growth rate
  - Age
  - (pregnancy and breast-feeding)

# Balanced diet

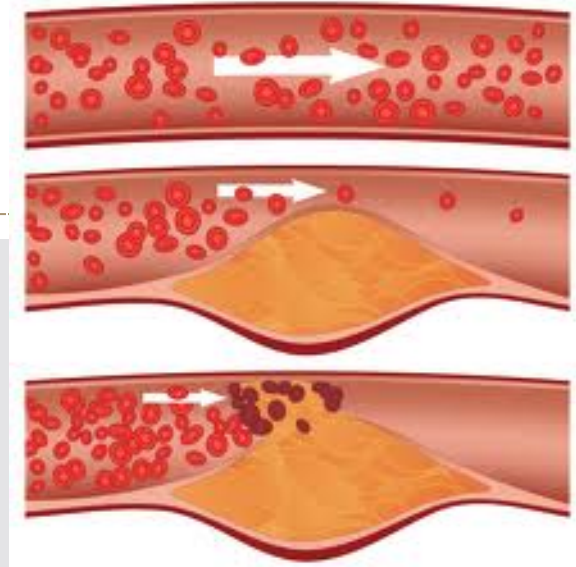


- What should it include?
- Why should we have a balanced diet?

# Types of fats



- Two types
  - Saturated: comes from animals
  - Unsaturated: fish and plants
    - ✦ Mono-unsaturated
    - ✦ Poly-unsaturated: helps with reducing cholesterol
- Saturated fats increase cholesterol
- Cholesterol is a chemical made in the liver and found in blood stream
- Quantity of cholesterol we produce depends on diet and genes
- Cholesterol is linked to narrowing arteries – develop heart disease and high blood pressure



# Types of fats

## Saturated fats

Saturated fats are found in animal products such as butter, cheese, whole milk, ice cream, cream, and fatty meats, and oils such as coconut, palm, and palm kernel oil



## Unsaturated fats



# BMR



- Basal Metabolic Rate (BMR) is the rate at which energy is used by an organism at complete rest
- Remember even if your at rest body needs energy for breathing, heart beating, homeostasis, body chemical reactions
- Varies from person to person
- About 7000 kJ per day

# BMR



- Children have higher BMR per kg because they are still growing & make new cells
- Elderly people – lower BMR – need less energy and protein needs
- Women have higher fat content than men – fat tissue have lower metabolic rate than muscle
- Pregnant/breast-feeding women need more nutrients
- Body builders – more muscles – more proteins

# Ideal mass



- Energy intake: amount of energy you get from your food in a day
- Energy output: energy used up by your body in a day
  - Intake = output  $\rightarrow$  ideal
  - Intake  $>$  output  $\rightarrow$  gain weight / overweight
  - Intake  $<$  output  $\rightarrow$  lose weight / underweight



# BMI



- Body mass index

$$\text{BMI} = \frac{\text{mass (kg)}}{(\text{height (m)})^2}$$

- < 20 underweight
- 20 – 24 ideal
- 25 – 30 overweight
- > 30 obese

# overweight



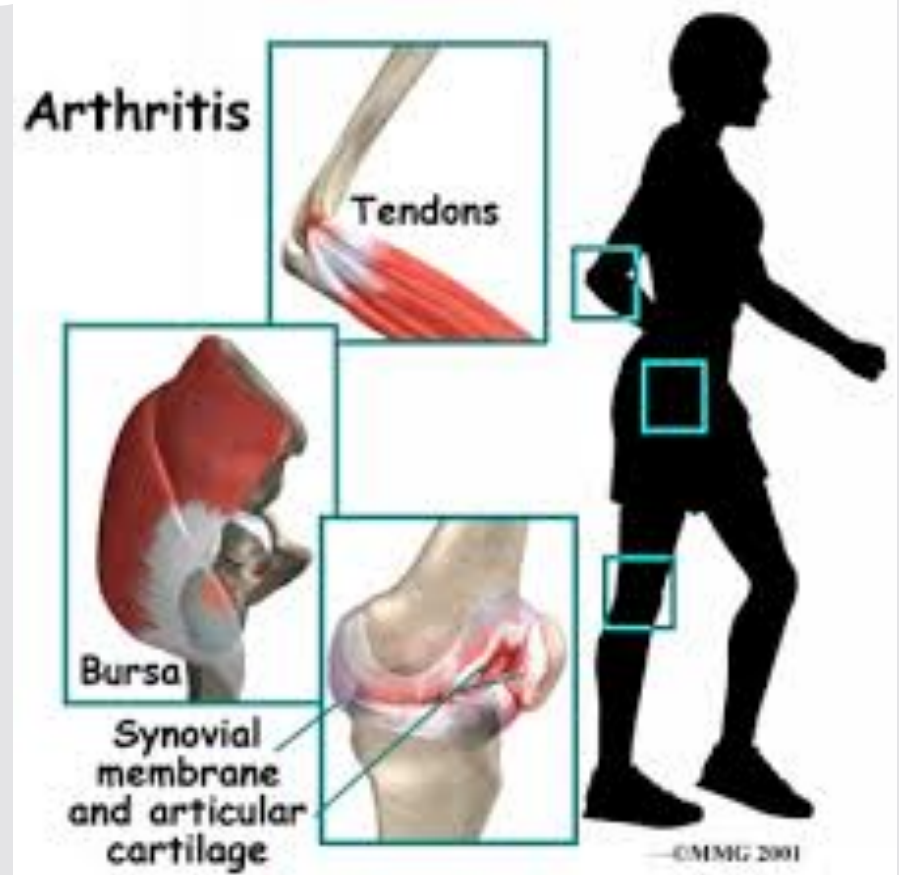
- Reasons:
  - Having low BMR
  - Eating high-energy foods / fattening foods (high fat content and/or refined food with lots of added sugar)
  - Not exercising
  - ‘Comfort eating’



# overweight

- Health issues:

- Heart disease
- High blood pressure
- Diabetes
- Arthritis



# Overweight

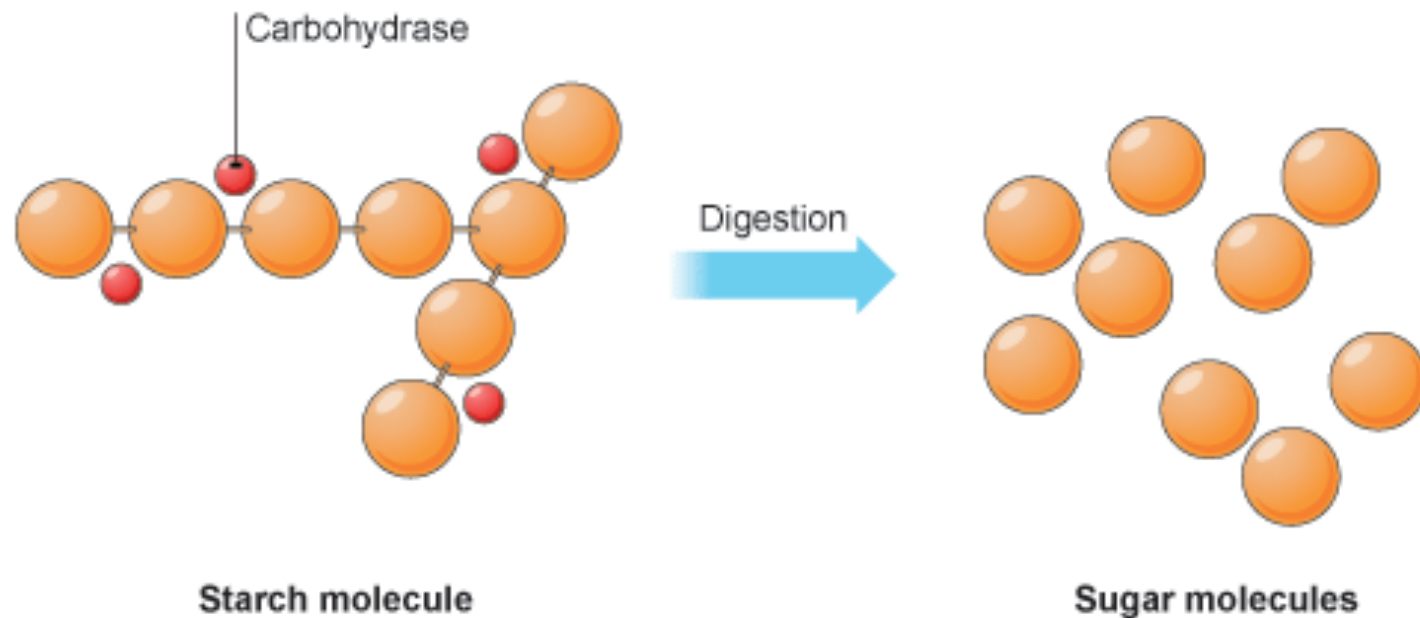


- Lose the weight
  - Eat less high-energy foods (fats)
  - Intake < output energy
  - More exercise
  - Build higher self-esteem and good self-image

# Digestion



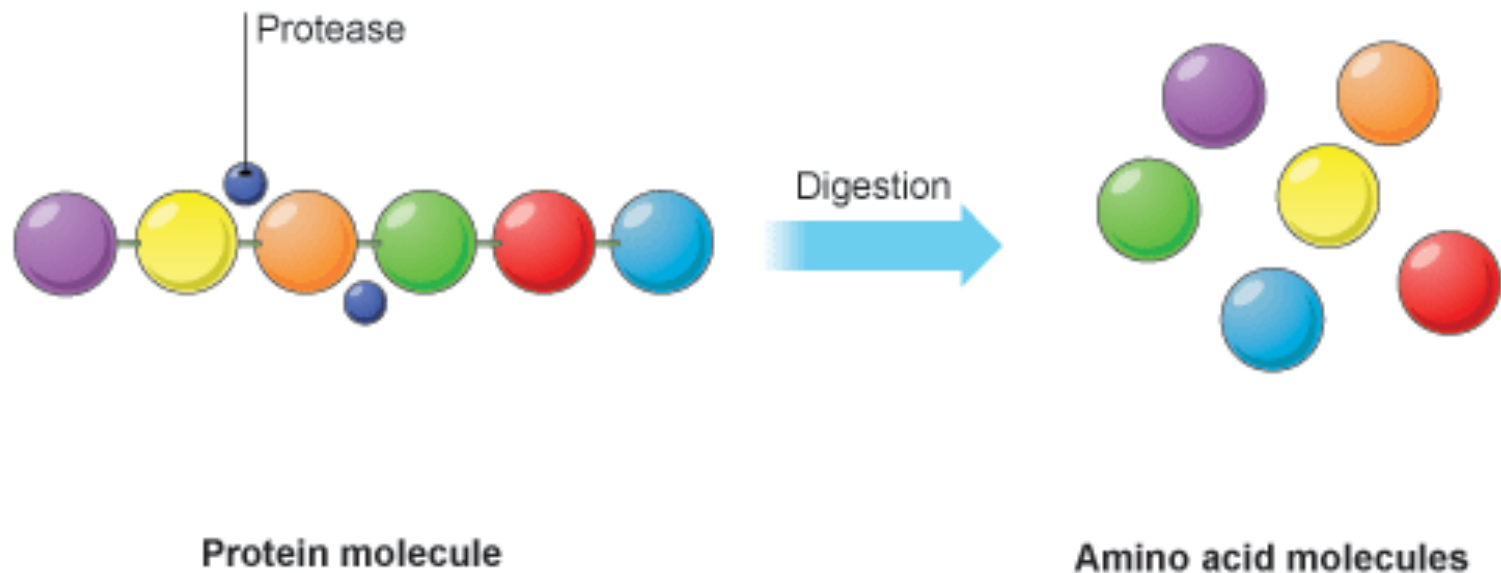
- Digestion: breakdown of large insoluble food molecules so they can be absorbed into the bloodstream



# Digestion



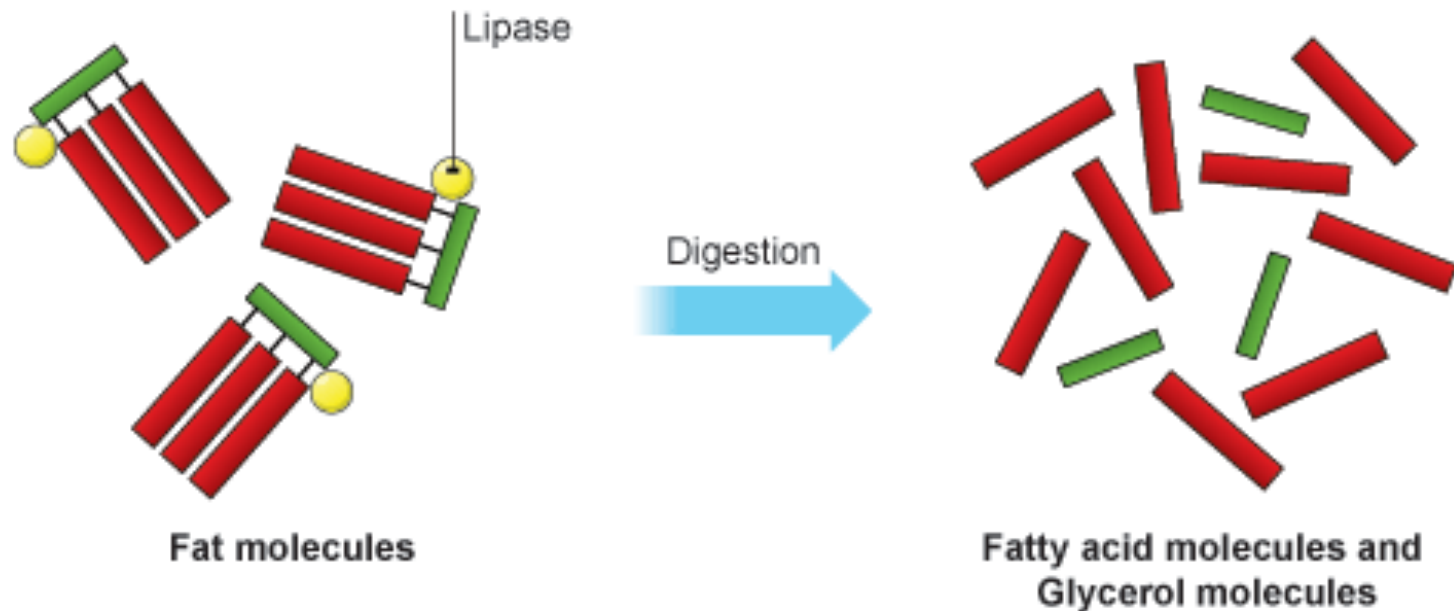
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# Digestion



- Digestion: breakdown of large insoluble food molecules so they can be absorbed into the bloodstream



# Digestion



- Occurs chemically and mechanically
- This happens in the alimentary canal with aid of liver and pancreas
- Mechanical (physical) digestion: breakdown of large food molecules into smaller ones without changing food molecules.
  - Starts at mouth(breaking into smaller pieces to be swallowed)
  - Muscular contractions in stomach continue breaking down
  - Small intestine break down large globules of fat into smaller ones by emulsification by bile



# Digestion



- Chemical digestion: breakdown of large food molecules into smaller molecules by enzyme action.
  - This happens in the mouth, stomach, and small intestine
  - Mechanical digestions gives a larger surface area for enzyme to work on

# Digestion



- Digestive tract VS digestive system:
  - Digestive tract: mouth, esophagus, stomach, small intestine, large intestine, rectum, anus
  - Digestive system: digestive tract + pancreas, liver, and gallbladder

# Mouth



- Ingestion: process of taking food and drink through mouth
- Physical digestion:
  - Food broken to chunks by incisor and canine teeth
  - Molar and premolar teeth to grind food more
- Chemical digestion
  - Tongue mixes food with saliva
  - saliva which has amylase which is secreted by salivary glands
  - Salivary gland also has mucus which lubricates passage of food bolus (food rolled by teeth and saliva moisture into a ball) down the throat

# Teeth

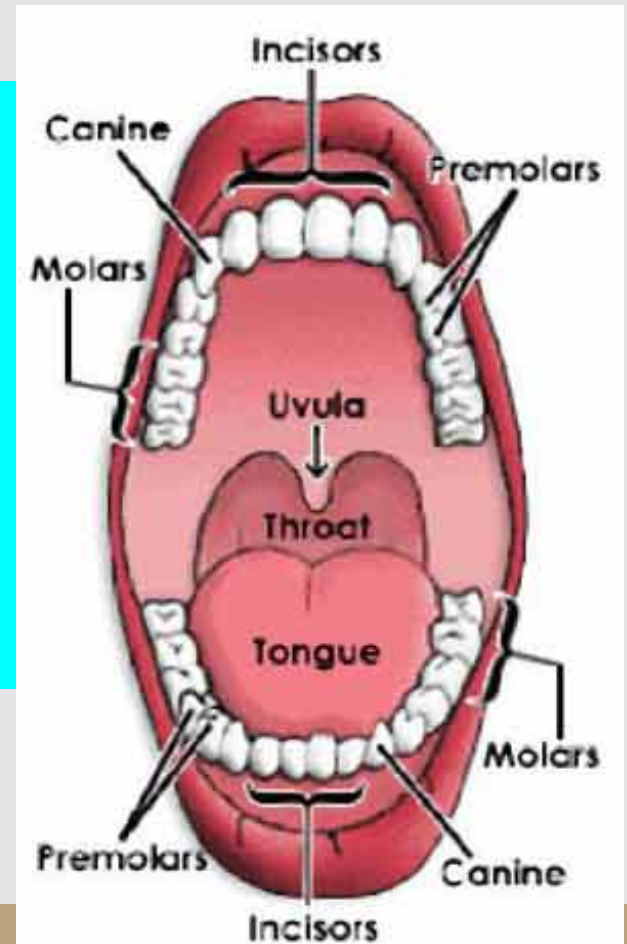
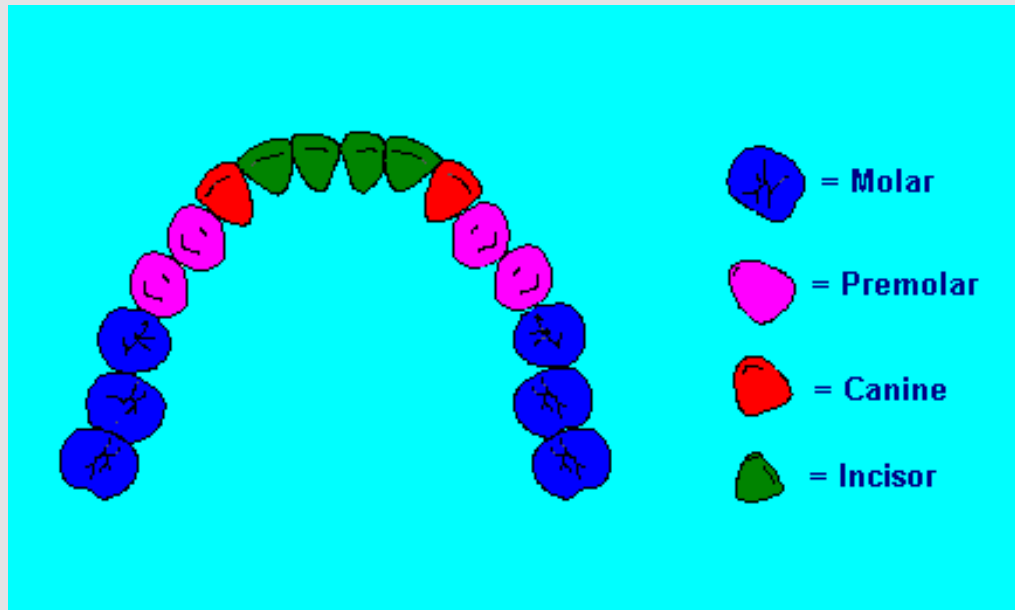


- Teeth carry out mechanical digestion (smaller pieces for more surface area for chemical digestion)
- Adult humans have 32 teeth
- Different functions:
  - Incisors: chisel-shaped for biting and cutting
  - Canines: pointed for piercing and tearing
  - Premolars: uneven 'cusps' for grinding and chewing
  - Molar: like premolars – chewing food

# Teeth



- 8 incisors – 4 canines – 8 premolars – 12 molars

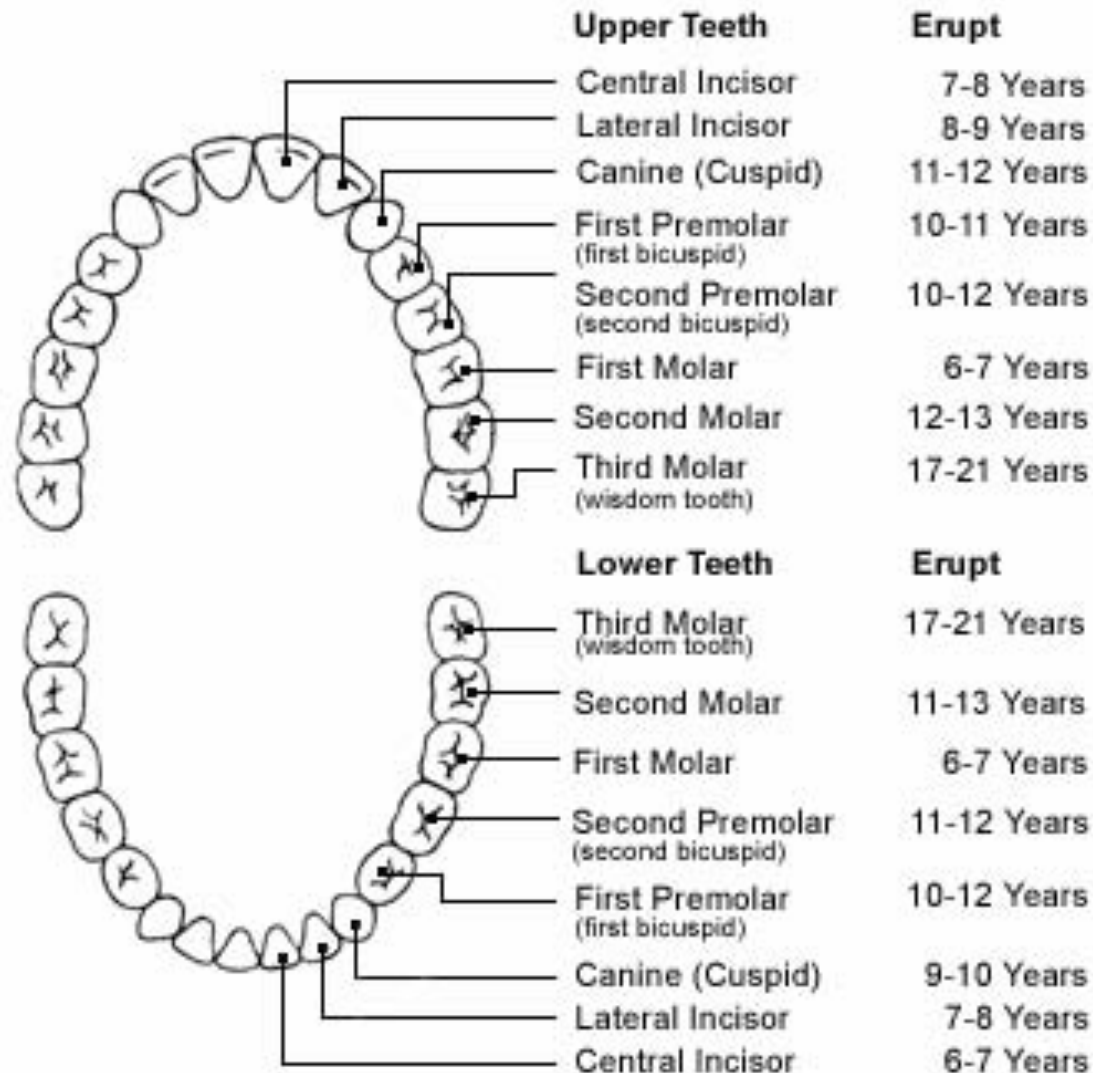


# Teeth



- Two sets of teeth:
  - Milk teeth: small teeth + only 8 molars / fall out between 6-12 / replaced
  - Permanent teeth: last teeth to come (wisdom teeth – back molars)

# Teeth



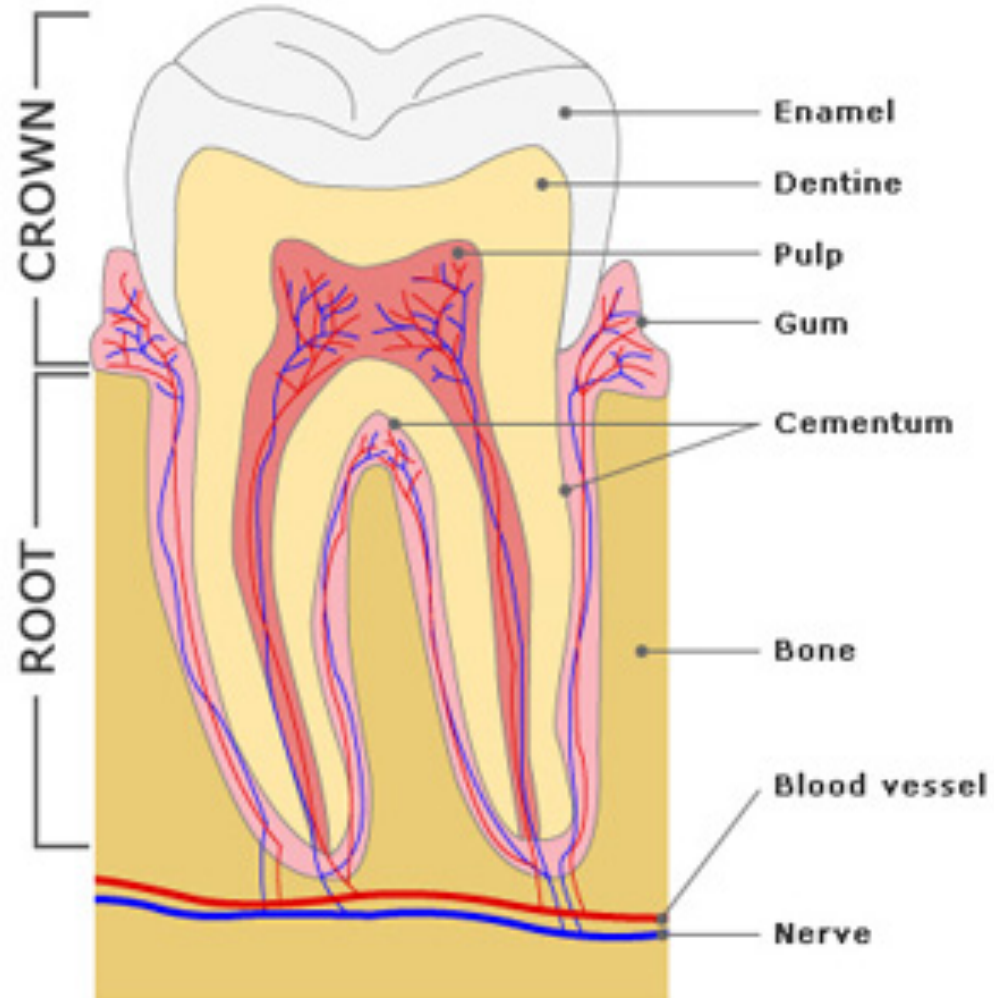
# Teeth



- Enamel: hard outer layer
- Dentine: soft inside (like bone in structure)
- Cement: fixes tooth inside bony socket in jaw
- Pulp cavity: space containing nerves and blood vessels



# Teeth



# Healthy teeth & gums

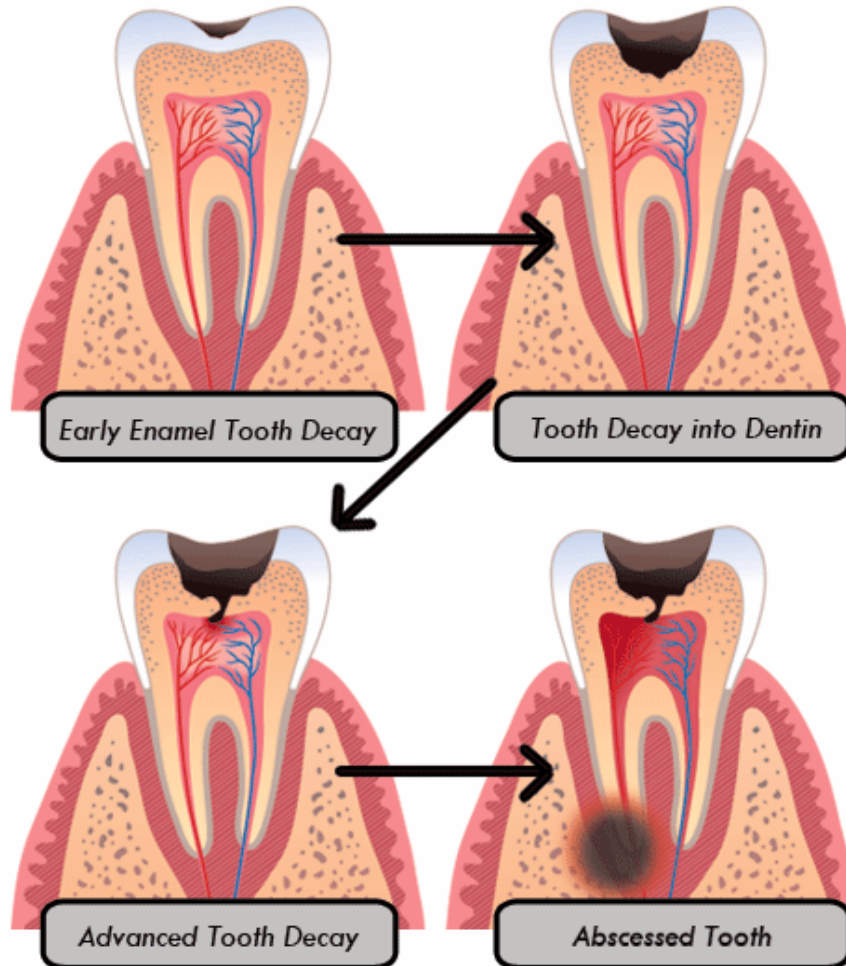


- Tooth decay caused by bacteria in mouth
- Bacteria + saliva → plaque
- Plaque is layer that sticks to you teeth and gums
- Bacteria + sugar in left food in teeth → acid
- Acid attacks enamel and start tooth decay
- After it attacks dentine then pulp cavity causing severe pain
- Acid makes gum red and swollen

# Healthy teeth & gums



## The Stages of Tooth Decay



# Healthy teeth & gums



- Fluoride strengthens teeth by making enamel more resistant to acid



# From mouth to stomach



- **Bolus:**
  - pushes soft palate up preventing food from going to nose
  - epiglottis covers opening to trachea
  - food squeezed esophagus (diagram p.79)
- **Esophagus (gullet):**
  - Peristalsis: muscles contract and squeeze (in a wave motion) behind the food to push it along to stomach.

# Stomach



- **Chemical digestion:**
  - Stomach walls produce gastric juice
  - Protein digestion:
    - ✦ This juice contains pepsin (a protease)
    - ✦ Breaks proteins to polypeptide
  - HCl (hydrochloric acid) also found in gastric juice kills bacteria in food
  - Pepsin therefore work at low pH 1.5-2.0
  - Food + gastric juice + HCl → chyme
- **Mechanical digestion:**
  - Mixing of chyme takes 2-3 hours with aid of stomach muscles

# Small intestine



- 6 meters long!!!
- Smaller diameter than large intestine
- Food come from stomach through timely muscle contractions
- Enzymes come from: pancreas, liver, and intestinal glands
- Intestinal glands: secrete carbohydrases, proteases, and lipases.
- Made from two parts
  - Duodenum
  - ileum

# Small intestine

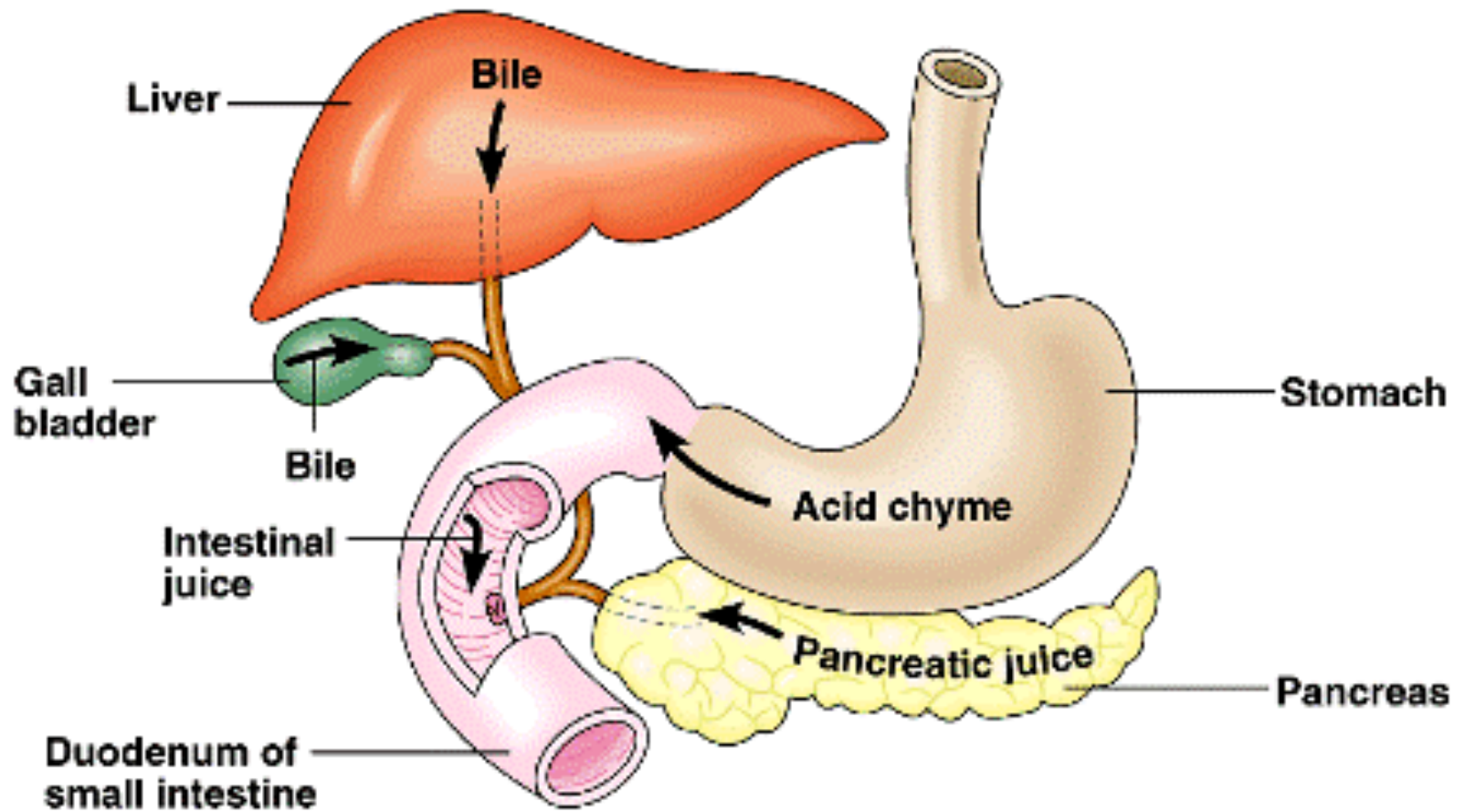


- **Duodenum:**

- Pancreas connect to it through **pancreatic duct**
- Pancreatic juice flows in duodenum – contains:
  - ✦ Amylase: breaks starch → maltose
  - ✦ Trypsin: protease breaks down protein → polypeptides and peptides
  - ✦ Lipase: breaks fats → fatty acid and glycerol
  - ✦ All enzymes work best in alkaline solution
- Pancreatic juice is alkali (neutralizes acid stomach)
- Bile enters duodenum by bile duct which is made in liver and stored in gall bladder
- Bile also alkali
- Bile emulsifies fats from large to small globules (not chemical digestion)



# Small intestine



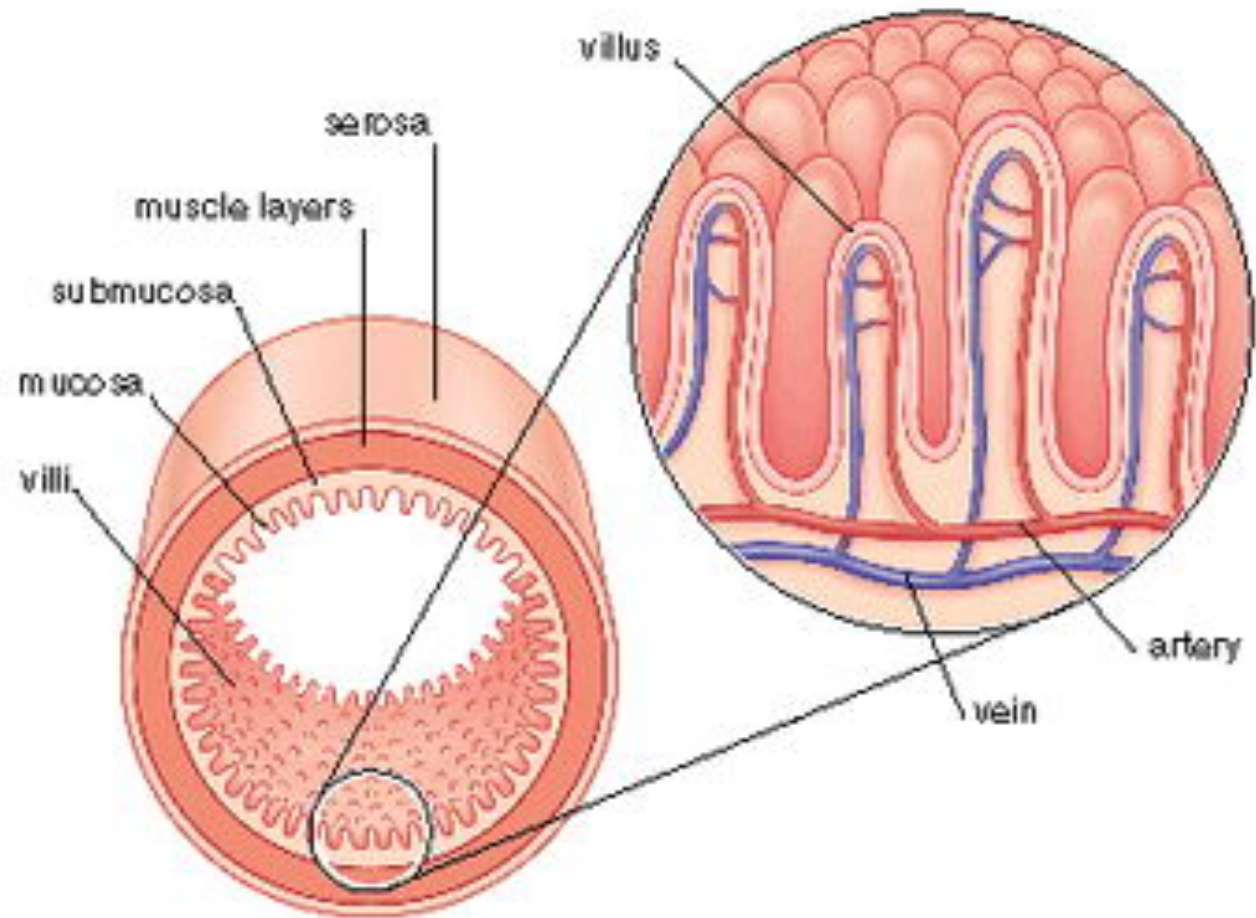
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# Small intestine



- ILEUM:
  - Make enzymes to further break food
  - Break them down to glucose, amino acid, and fatty acids and glycerol
  - Absorption takes place – job of villi
  - Absorption: movement of digested food molecules through the wall of the intestine into the blood or lymph
  - Some water is also absorbed
  - Pass by diffusion or active transport
  - To increase absorption the ileum has:
    - ✦ Large surface area
    - ✦ Good blood supply
    - ✦ Thin lining- for food to cross easily

# Villi



# Large intestine



- Is made from the colon
- Water is reabsorbed here
- Waste (faeces) are stored in the rectum
- Waste = fibre + dead cells + bacteria + water
- Waste are ejected through the anus. This process is called egestion

# Assimilation



- Assimilation: food molecules that have been absorbed now become part of the cells or are used by the cells.
- As part of assimilation, the liver carries out important functions:
  - Stores glucose (takes it from blood and stores it as glycogen) – this controls blood sugar
  - Use amino acids to make proteins (e.g. for blood clots)
  - Breaks down excess amino acid
  - Converts fatty acid and glycerol to fats to be stored
  - Produces cholesterol from fats